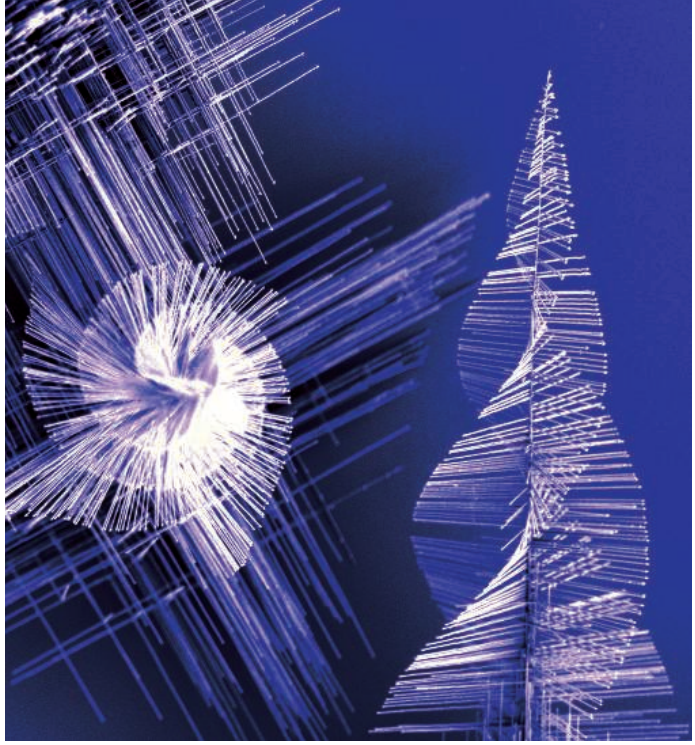


<< Building Nano-Pine Trees

While nanoscale wires and rods hold tremendous potential in electronics, optics, or catalysis, one limitation is in the patterning or development of hierarchical structures. Branched wires can be grown using metal nanoparticles or by changing the composition or growth conditions of the wire, but **Bierman *et al.*** (p. 1060, published online 1 May) now show a growth mechanism that is driven solely by the screw component of a single dislocation along the long axis of the nanowire. The nanowires have a pine tree morphology, with regular branches spawning off a thicker trunk, and the growth agrees with the theory of how screw dislocations relax at surfaces.

Improving the Strength of Steel

Steel will typically lose strength and ductility at lower temperatures, becoming weaker and more brittle, which may have contributed to the sinking of the Titanic. Solving this problem usually requires the addition of a number of alloying elements that can significantly raise the cost of the steel. **Kimura *et al.*** (p. 1057; see the Perspective by **Morris**) have developed a low-alloy steel with elongated grain structure that shows an inverse temperature dependence of the strength and ductility, so that the materials' properties improve as the temperature is lowered.

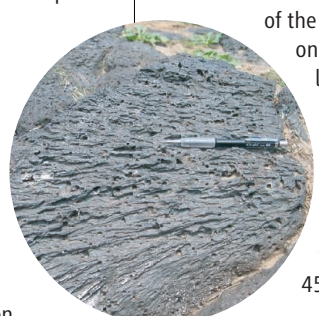
Regulating S-Nitrosylation

Covalent modification of proteins by S-nitrosylation is an important mechanism for regulation of biochemical activity in cells. However, mechanisms of protein denitrosylation have not been well characterized. The protease caspase-3, which promotes apoptosis, is inhibited by S-nitrosylation and is denitrosylated in cells in which the cell death–promoting receptor Fas is activated. **Benhar *et al.*** (p. 1050; see the Perspective by **Holmgren**) purified a protein fraction that catalyzed denitrosylation of caspase-3 and identified thioredoxin-1 (Trx1) as the protein most likely to be responsible for the denitrosylation activity. Depletion of Trx1 caused accumulation of S-nitrosylated caspase-3 and other S-nitrosylated proteins in cultured cells, and Fas-induced denitrosylation of caspase-3 was inhibited by depleting thioredoxin reductase 2. Thus, regulated denitrosylation of target proteins by Trx1 appears to provide a key component of enzymatic regulation of caspase-3 and possibly other proteins by S-nitrosylation.

CREDITS (TOP TO BOTTOM): M. J. BIERMAN, Y. K. A. LAU, S. JIN; LAMB *ET AL.*

Here Comes the Flood

One piece of evidence supporting the presence of past groundwater on Mars has been canyons that start in a steep amphitheater shape. Similar canyons on Earth have been interpreted as marking areas of seepage and flow of groundwater.



Lamb *et al.* (p. 1067) now show that one of the examples, Box Canyon, Idaho, on the Snake River Plain, is likely to have formed during a glacial-aged megaflood, not by gradual erosion caused by groundwater seepage. Cosmogenic dating of boulders in the canyon suggests that the flood was about 45,000 years ago.

Sodium Gets Complex Under Pressure

Until recently, the pressure-temperature-phase diagram of elemental sodium, while exhibiting a curious minimum melting transition under high pressure, was thought to be understood fully. Using state-of-the-art, high-pressure x-ray synchrotron single-crystal diffraction techniques to focus in on the minimum melt regime, **Gregoryanz *et al.*** (p. 1054) report a remarkable concentration of different crystalline phases (6 within a 4-GPa window) that were not predicted by theory. While the mechanism giving rise to such complex behavior remains unclear, such structural complexity may be par for the course, even for simple elements like hydrogen.

Fishing for Viruses

We understand very little about how microbial viruses influence the natural environment. Using sequence data gathered from acid mine microbial communities, **Andersson and Banfield** (p. 1047) have taken advantage of the recent discovery of what appears to be a prokaryotic defense mechanism against viruses to identify "wild" viruses in uncultured biofilms. Several classes of viruses were identified, and the analysis suggests that a rapidly changing population of viruses and host microbes is engaged in a defensive arms race of sequence shifting.

Martian Opal

Extensive deposits of nearly pure silica—either as quartz or opal—are indicative of complex secondary processes, including the involvement of fluids. **Squyres *et al.*** (p. 1063) now report the discovery of opaline silica deposits on Mars by the rover Spirit. Thermal emission data show that the deposits, which include nodules on an outcrop, rock samples, and light-colored soil excavated by the rover wheel, are opal, not quartz or cristobalite. Formation is likely to have involved hydrothermal fluids at low pH, perhaps associated with past volcanic activity in the region.

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Two Clocks Are Better Than One

The circadian clock of mammals resides within the hypothalamus, in the suprachiasmatic nucleus, and it is entrained by light. There is evidence that another circadian clock—entrained by food—also exists in the brain, possibly elsewhere in the hypothalamus. By replacing a missing clock component (*Bmal*) in selected hypothalamic nuclei of mice lacking *Bmal1*, **Fuller *et al.*** (p. 1074) identified the dorsomedial nucleus of the hypothalamus as the site of the food-entrained clock. When *Bmal1* was reintroduced selectively into the suprachiasmatic nucleus, the previously unresponsive mice regained the ability to entrain both locomotor activity and body temperature rhythms to a 12:12 light:dark cycle. Reintroduction of *Bmal* into the dorsomedial nucleus restored the ability of the animals to entrain to a restricted period of food availability, but not to a light cycle. Thus, the dorsomedial nucleus contains a second circadian clock that seems to be induced when food is restricted to take over control of functions such as activity levels that increase the chances of the animal successfully locating additional food resources.

Widening RNA Interference Functions

In plants, fungi, and worms, RNA interference (RNAi) functions to silence endogenous repeated and parasitic DNA, including transposons. In flies and mammals, a distinct RNA-based silencing pathway involving Piwi-interacting RNAs (piRNAs) operates in the germ line to silence the parasitic DNA there. **Ghildiyal *et al.*** (p. 1077, published online 10 April; see the Perspective by **Birchler and Kavi**, published online 8 May) now show that *Drosophila* somatic cells produce endogenous small interfering RNAs (siRNAs). Like piRNAs, many of the endogenous siRNAs map to large genomic clusters that include transposons and repeated sequences, but also to messenger RNAs (mRNAs), suggesting that endogenous siRNAs may regulate mRNA expression.

A Sweet Tale of Gene Hunting

Epidemiological studies have shown that even modest elevations in fasting plasma glucose (FPG) levels predict an elevated risk of cardiovascular disease, even when these levels fall within the "normal" range and are not associated with type 2 diabetes. The molecular mechanisms controlling FPG levels in humans are incompletely understood. Using data from a genome-wide association study, **Bouatia-Naji *et al.*** (p. 1085) identified a single nucleotide polymorphism (SNP) that contributes to the interindividual variation in FPG levels in normoglycemic individuals. The SNP resides within an intron of the *G6PC2* gene, which encodes glucose-6-phosphatase catalytic subunit-related protein (also known as IGRP). This protein is selectively expressed in pancreatic islets and is thought to function by modulating the set point for glucose-stimulated insulin secretion.

Unmasking the Sensor of Iron Deficiency

Iron deficiency is common among animals. Human cells can sense and utilize iron taken up by the body from food sources; however, the mechanism for perception of low iron availability has remained obscure. By positionally cloning the gene mutation responsible for the mouse "mask" phenotype, characterized by iron deficiency anemia and progressive loss of body (but not facial) hair, **Du *et al.*** (p. 1088, published online 1 May) have identified a critical element of the "low iron" detection apparatus. The cell surface protease transmembrane serine protease 6 acts to inhibit the production of hepcidin, the master repressor of intestinal iron absorption. The transmembrane serine protease 6 mutation involved in the mask phenotype specifically impairs dietary iron absorption, highlighting the importance of this homeostatic pathway.

CREDIT: DU *ET AL.*

Kindness or Fairness?

It's easy to propose that allocations of scarce resources should provide the greatest benefit to a group as a whole and be as fair as possible to individual members of the group, but what should be done when both aims cannot be optimized simultaneously? **Hsu *et al.*** (p. 1092, published online 8 May; see the 9 May news story by **Miller**) use functional brain imaging, not to resolve these dilemmas, but to probe the underlying cognitive and emotional processes supporting one view (favoring equity, for instance) versus the other (maximizing the good). Brain regions involved in encoding reward relate also to calculations of total benefit, whereas the balancing of equity and utility seems to be the province of the insula, which connects with emotion-processing neural systems. Thus, judgments of fairness derive from emotion-based preferences, rather than those of pure reason.